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H. H. Arnold
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MANAGEMENT OF COMMON EYE DISORDERS

U.S.

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MANAGEMENT OF COMMON EYE DISORDERS

Foreword

1. The accompanying outline of the diagnosis and treatment of ocular disorders in military personnel is designed to supply the medical officer with a conservative routine for the management of cases commonly encountered.

2. As a portion of the central nervous system the eye is peculiarly vulnerable to trauma and disease and a great deal of specialized training is required for the recognition and management of disorders relating to it. It is recommended, therefore, that whenever possible all but simple conditions be referred to an ophthalmological consultant.

3. This manual is not to be construed as restricting qualified specialized medical personnel from deviating from recommendations contained herein. It is published for the information of the medical officer and is not a directive.

4. Requests for copies will be submitted to Headquarters, AAF, Attention: Air Surgeon.

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TABLE OF CONTENTS

SECTION I. GENERAL RECOMMENDATIONS.

1. TYPE OF CARE.

a. Outpatient Care. Most cases of external disease of the eye or those requiring minor surgical procedures on the lids can be cared for on duty status as outpatients. All cases which do not progress satisfactorily should be referred to a dispensary or hospital where an eye consultant is available.

b. Hospital Care. Hospitalization is recommended for the following types of cases:

(1) Conditions which prevent performance of duty for more than 24 hours by reason of discomfort or disturbance of visual function.

(2) All cases of intraocular injury or inflammation.

(3) Extraocular injuries of the following types:

(a) Lid lacerations if they involve the lid margin or the entire lid thickness.

(b) Injuries to the globe other than superficial abrasions, contusions, or minor foreign bodies.

(4) All cases with increased intraocular pressure from any cause.

(5) All cases of severe purulent or granular conjunctivitis.

2. EXAMINATION.

a. Vision in both eyes should be determined as part of every examination and before any treatment is undertaken. If the 20/200 letter cannot be read at 20 feet the patient is advanced toward the chart until this letter can be read. If the letter cannot be read at any distance, the ability to perceive hand motions or only light in the eye is recorded. The numerator of the fraction for designating vision is the distance from the chart, the denominator the line read.

b. Initial inspection should be done if possible by daylight, by focal illumination from a good projection lamp, by the aid of a magnifying lens, and finally by use of the ophthalmoscope. The lids, conjunctiva, cornea, anterior chamber, iris, and pupil should be inspected and the movement of the eyeballs examined for nystagmus and for impairment of movement in any direction.

c. Spasm of the lids may necessitate the instillation of one or two drops of 2% butyn sulfate solution or 1/2% pontocaine solution to ease pain and reduce spasm sufficiently to insure satisfactory inspection.

d. Ophthalmoscopic examination is required for conditions deeper in the eye than the pupil and should be made in a dimly illuminated room. To ascertain the condition of any portion of the interior of the eye it is usually necessary to dilate the pupil. One drop of homatropine solution 2% may be instilled in the eye. In persons over 40 years of age a drop of paredrine solution 1%, or cocaine 4%, or adrenalin 1 to 1000 is preferable; one or more types of drops may be used in combination. In persons of this age group it is advisable after completion of the examination to use a miotic such as 1/4% eserine salicylate or 1% pilocarpine nitrate to constrict the pupil.

3. TREATMENT AND GENERAL PRINCIPLES.

The therapeutic principles of general medicine and surgery are applicable to the eye, but the minuteness and delicacy of its structures and the transparency of the ocular media necessitate more than usual precautions to maintain the integrity of the normal protective mechanisms of the region and to guard against overtreatment.

a. Directions for specific treatments.

(1) Irrigation. Boric acid solution (saturated), sterile water, or normal saline is flushed into the lower fornix and against the cornea and bulbar conjunctiva with some force,

the operator using a medicine dropper in one hand and pulling down on the lower lid with the thumb of the other hand, at the same time having the patient look up and down alternately.

(2) Instillation of drops. A square of 2x2 gauze or cotton is placed on the lower lid and the lid pulled down by pressure. The patient is asked to look up, the medicine dropper is placed on the lower lid, and one or two drops of the solution are squeezed out.

(3) Instillation of ointment. If the ointment is to be instilled from a tube, about one-half inch is squeezed into the lower fornix. If it is in bulk, a pea-sized amount or less can be taken on the end of a toothpick or applicator and placed on the everted lower lid. The patient is directed to close his eye and the applicator is then pulled away.

(4) Compresses.

(a) Hot applications are used for 20 minutes out of each two hours. If applied over a considerable period of time the skin of the eyelids should be coated with a bland ointment to prevent maceration. A gauze or cotton pad of sufficient thickness to retain heat is dipped in hot water, wrung out, and placed on the lid. A hot water bottle applied over a damp cloth is equally satisfactory. Care should be taken to avoid burns. Patients applying their own hot packs may use a good-sized wad of cotton on a wooden tongue depressor; this is dipped in the hot water and applied to the eye repeatedly.

(b) Cold compresses can be applied in the same manner, cracked ice being used to lower the temperature of the water.

(5) Dark glasses for relief of photophobia due to inflammation are not furnished by the Army. They may be obtained in most Post Exchanges, the cheap ones being as satisfactory for temporary use as the more expensive.

(6) Simple eye dressing. Two pieces of 2x2 gauze or a special eye pad is laid over the closed lids. Two or three 6-inch strips of 1/2 inch adhesive tape are then fixed over the gauze, from cheek bone to mid-forehead, to hold the gauze in place. The adhesive should be at a 45-degree angle so that chewing and talking will not displace the dressing.

(7) Pressure dressing. One piece of 2x2 gauze or a special eye pad is placed over the closed lids. Two or more pieces of fluffed up gauze or cotton are then placed on top of the pad. Five or six 6-inch strips of 1-inch adhesive are required. The first strip is laid across the center of the dressing at a 45-degree angle from the cheek bone to the center of the forehead to hold the dressing in place. The other strips are then fixed roughly parallel to the first with considerable pressure until the dressing is covered and pressed tightly against the closed lids.

SECTION II. OUTPATIENTS EYE CLINIC INSTRUMENTS AND MEDICATIONS.

1. INSTRUMENTS AND MEDICAL SUPPLY CATALOG NUMBER.

   a. 3133000 Curette chalazion, medium.

   b. 3218000 Forceps, chalazion, 3 3/4 inch, Lambert.

   c. 3218300 Forceps, cilia, 3 inch, Douglas.

   d. 3227000 Forceps, fixation with catch.

   e. 3228000 Forceps, fixation without catch.

   f. 3229000 Forceps, hemostatic mosquito, 5 inch (6).

   g. 3242000 Forceps, iris, 4 inch, straight.

   h. 3275000 Forceps, towel, 3 inch, Backhaus.

   i. 3305000 Hook, strabismus, medium (2).

   j. 3336500 Knife, operating, handle No. 3, Bard-Parker.

   k. 3337000 Knife, operating, Blade No. 11 (6).

   l. 3337300 Knife, operating, Blade No. 15 (6).

   m. 3347000 Lens, eye, condensing.

   n. NS-3 Lamp, condensing.

   o. Sig. C Flashlight (preferably with focal illumination).

   p. 3372500 Needle, eye, Size 2, cutting edge.

   q. 3402900 Ophthalmoscope, electric with battery handle.

   r. 3422000 Plate lid, Jaeger.

   s. 3447000 Retractor, eye, medium, Desmarres.

   t. 3481000 Scissors, strabismus, straight.

   u. 3482000 Scissors, tenotomy, Stevens.

   v. 3518000 Speculum eye, Weeks.

   w. 3536000 Spud eye, Dix.

   x. 3796900 Suture, silk, braided, Size 000.

   y. 3788900 Suture, eye, Silk, Size 4-0, double armed (12).

   z. 3879900 Vision test card, near vision.

   a' 3884000 Vision test set, test type card, Snellen.

   b' 7795000 Dropper, medicine (12).

2. MEDICATIONS AND MEDICAL SUPPLY CATALOGUE NUMBER.

   a. 1012500 Acid, boric, ophthalmic ointment, 12 tubes.

   b. 1087500 Atropine sulfate ointment 1%, 12 tubes.

c. 1175200 Epinephrine hydrochloride solution, 5 cc, 1/1000.

d. 1178800 Eserine sulfate ophthalmic ointment, 1/4 %, 12 tubes.

e. 1285715 Merthiolate ophthalmic ointment, 12 tubes.

f. 1285815 Metaphen ophthalmic ointment, 12 tubes.

g. 1464000 Sulfathiazole opthalmic ointment, 5%, 12 tubes.

h. 9102800 Bal ointment, 3/4 oz. tube.

i. 9109100 Eye and nose drops, 1/2 oz. with separate dropper.

For irritant smoke casualties.

3. The following drugs will be made up by the pharmacy:

a. Atropine sulfate solution, 1%.

b. Homatropine hydrobromide solution, 2%.

c. Paredrine solution, 1%.

d. Eserine sulfate solution, 2%.

e. Fluorescein solution, 2%.

f. Cocaine sulfate solution, 4%.

g. Butyn sulfate solution, 2%.

h. Pilocarpine nitrate solution, 1%.

i. Pontocaine solution, 1/2%.

j. Oxycyanide of mercury 1-5,000 solution.

k. Zinc sulfate 1/4% solution.

l. Yellow oxide of mercury 1% and salicylic acid 1% in petrolatum or other ointment base.

m. Ammoniated mercury ointment, 2%.

n. Mercurochrome 2% aqueous solution.

SECTION III. DISORDERS OF THE EXTERNAL EYE AND ADNEXAE.

1. EYELIDS.

The skin of the eyelids is thinner and less adherent to the underlying structures than the skin elsewhere on the face and is therefore more reactive to skin infections and allergies. Allergic dermatitis may be apparent in this location only, although other skin areas may be equally exposed.

a. Allergic dermatitis always involves the entire lid surface and is manifested by a thickened, hyperemic, scaly skin which itches intensely.

Treatment: (1) Avoidance of contact with the allergic factor which may be ascertained by patch tests with suspected materials on the flexor surface of the arm. Most common offenders in military life appear to be local medications, soaps and shaving lotions, and metal-framed glasses.

(2) Calamine lotion with 1% phenol added is useful in relieving itching and may be applied two or three times daily.

b. Blepharitis marginalis is a chronic infection of the lid margins of diverse etiology, caused most commonly by pathogenic staphylococci but also frequently appearing as an extension of seborrheic dermatitis of the scalp, brows, or external ears. The squamous type is characterized by crusting and scaling and the ulcerative type by minute abscesses and ulcers at the bases of the cilia.

Treatment: (1) Removal of crusting and scales once or twice daily with moist gauze or cotton applicator.

(2) Application of 2% ammoniated mercury ointment or 5% sulfathiazole (ophthalmic) ointment, or an ointment composed of 1% yellow oxide of mercury and 1% salicylic acid, to the lid margins four times daily. Sulfathiazole ointment should not be used over long periods because of the possible danger of sensitization.

(3) If the Meibomian glands are infected the medical officer should express them every other day by compressing the tarsal plates together between the fingers.

c. Stye or external hordeolum is an acute, painful, staphylococcic inflammation of one of the sebaceous glands of the cilia. It differs in location from the internal or Meibomian stye which may lead to chalazion.

Treatment: (1) Hot compresses until pointing occurs; then incision and drainage.

(2) An antiseptic ointment such as 5% sulfathiazole (ophthalmic) or one of the mercurial ointments should be applied to the lid margin twice daily for a week or more to prevent the infection of other glands.

d. Internal hordeolum or Meibomian stye differs from the external stye in that the substance of the tarsus is involved.

Treatment: Spontaneous rupture is rare and incision through the conjunctival surface is indicated as soon as localization occurs to prevent the development of chalazion. Treatment otherwise is as for external hordeolum.

e. Chalazion is a cyst of one of the Meibomian glands which run vertically in the tarsal plates. It often follows a staphylococcic Meibomian stye which has blocked the duct. Although chalazion frequently appears without inflammatory signs, there is usually an initial edema of the lids with pain and tenderness. When these symptoms subside there remains in the tarsal plate a firm nodule which occasionally ruptures into the subconjunctival or subcutaneous tissues.

Treatment: (1) Hot compresses in the acute phase; as for blepharitis in the chronic phase.

(2) If recurrent, annoying, or large enough to be a cosmetic blemish, surgical removal when the acute symptoms have subsided is indicated.

Suggested surgical procedure: The conjunctiva is anesthetized by instillation of cocaine 4%, butyn 2%, or pontocaine 1/2%. Lid anesthesia is obtained by injection of approximately 0.5 cc. of 2% procaine solution into the fornix beneath the chalazion after eversion of the lid. If the chalazion is near a canthus additional injection through the skin surface around the mass may be required. After waiting five minutes for anesthesia to take place, the operator applies the chalazion forceps with the ring on the skin surface or conjunctival surface toward which the chalazion is pointing. Incision is made vertically when the conjunctival approach is used, horizontally when the skin approach is used. In the latter case a skin antiseptic such as tincture of mercresin is applied to the skin before operation. The contents and cyst walls of the chalazion are thoroughly scraped out with a curette. No sutures are necessary for the conjunctiva but in the external method fine silk sutures are used to close the skin. These sutures should be removed after 48 hours.

f. Tumors of the lid such as verruca, papilloma, naevus, xanthoma, and fibroma usually cause no symptoms and should be removed only if grossly disfiguring. Carcinoma, either basal cell or squamous, though most commonly seen as the end result of senile hyperkeratosis, may occur at any age. A recurrent or long-standing crusting ulcer suggests this lesion.

Treatment: Hospitalization for surgical removal. In late extensive infiltrating growths radium therapy may be preferable.

g. Ptosis, or drooping of the upper lid, is often congenital and may be disregarded unless the lid edge is low enough to interfere with vision. If the condition arises from any other cause, except acute and temporary inflammation of the lid, the patient should be referred to an eye consultant. Myasthenia gravis and third nerve paralysis due to syphilis or injury are frequent causes of ptosis of acute onset.

h. Entropion is the turning in of a lid margin with consequent rubbing of lashes on the cornea.

Treatment: Hospitalization for surgical correction; epilation gives only temporary relief.

i. Ectropion is the turning out of a lid margin which may expose the cornea to drying.

Treatment: Hospitalization for plastic repair.

2. LACRIMAL APPARATUS.

Dacryocystitis is an inflammation of the lacrimal sac which lies in the lacrimal fossa between the eyeball and the bridge of the nose. It is usually due to blockage and infection of the naso-lacrimal duct with pyogenic cocci.

a. Acute dacryocystitis is characterized by a painful, red swelling with exquisite localized tenderness at the inner canthus; it is sometimes confused with erysipelas, furuncle, or an infected sebaceous cyst.

Treatment: (1) Hospitalization; sulfadiazine or sulfathiazole in full therapeutic dosage is indicated and may abort early cases.

(2) When pointing develops, incision and drainage are necessary.

(3) After the acute symptoms have subsided, surgical treatment, preferably dacryocystorhinostomy, is usually necessary to prevent recurrence or the development of chronic dacryocystitis.

b. Chronic dacryocystitis is characterized by constant lacrimation and regurgitation of mucopurulent material through the puncta on pressure over the lacrimal sac. The danger in this disease is that if an abrasion of the cornea occurs ulceration is likely to follow due to the presence of bacteria of exalted virulence.

Treatment: Hospitalization for attempted relief of obstruction by probing or dacryocystorhinostomy.

3. CONJUNCTIVA.

The medical officer must be able to distinguish conjunctival congestion, as it occurs in conjunctivitis, from ciliary congestion, which is present in keratitis, uveitis, and glaucoma. Conjunctival congestion is characterized by a pink or light red color, by tortuosity of the vessels which are superficial and movable with the conjunctiva, and by an increasing intensity toward the periphery and on the under surface of the lids. History of discharge or its presence in the eye is indicative of conjunctival involvement. Ciliary congestion, on the other hand, increases toward the cornea and is characterized by the dark red or violaceous color of the enlarged vessels which lie under the conjunctiva and are not movable with it. In ciliary congestion the conjunctiva lining the lids is usually normal.

a. Acute purulent conjunctivitis is characterized by abundant purulent discharge and immediate smear and culture examination should be made to rule out gonococcic or meningococcic infection. Early diagnosis, prior to the development of corneal ulceration, is essential since early sulfonamide or penicillin therapy given systemically is uniformly successful in preventing corneal complications.

Treatment: (1) Hospitalization; isolation; full therapeutic doses of sulfathiazole, sulfadiazine, or penicillin.

(2) The eye should be kept free from exudate by gentle irrigation with warm boric acid or physiological salt solution.

b. Acute catarrhal conjunctivitis, the typical pink eye, is caused most commonly by the pneumococcus, the Koch-Weeks bacillus, or Staphylococcus aureus. The discharge is typically mucopurulent in character in contrast to the thick, purulent discharge of gonorrheal ophthalmia.

Treatment: (1) 1/4% zinc sulphate solution 4 x daily, or 5% sulfathiazole (ophthalmic) ointment 4 x daily, or 1 to 5,000 oxycyanide of mercury drops 4 x daily.

(2) Boric acid irrigation to remove secretion before treatment is advisable.

c. Chronic catarrhal conjuncitivitis is also caused by a diversity of microorganisms, the most common being Staphylococcus aureus and the Diplobacillus of Morax-Axenfeld. Cases resistant to local therapy are usually secondary to disease of the canaliculi, lacrimal sac, or lid margins. Chronic conjunctivitis secondary to staphylococcic blepharitis is by far the most common form seen under military conditions.

Treatment: (1) Attention to blepharitis or dacryocystitis when present.

(2) 5% sulfathiazole (ophthalmic) ointment 4 x daily, or 1/4% zinc sulfate solution 4 x daily, or 1 to 5,000 oxycyanide of mercury solution 4 x daily.

d. Membranous and pseudomembranous conjunctivitis are characterized by an opaque membrane over the surface of the conjunctiva, the difference between the two types being largely one of degree. The condition, in either degree, is most often caused by diphtheria bacilli or hemolytic streptococci, but occasionally is seen as a complication of erythema multiforme or ocular pemphigus. It is dangerous because of the frequency of corneal ulceration.

Treatment: Hospitalization; bacteriological study; sulfadiazine or penicillin for streptococcic cases, diphtheria antitoxin for C. diphtheriae cases. No specific treatment is available for cases complicating erythema multiforme or pemphigus.

e. Trachoma is a virus disease characterized by follicles and scarring, most prominent in the conjunctiva of the upper lids and fornix, and by vascularization and infiltration (pannus) of the cornea, particularly above. Early cases, prior to the development of scar-formation and gross pannus, are difficult to diagnose and require the use of a slit-lamp and corneal microscope.

Treatment: Hospitalization; isolation; sulfanilamide or sulfadiazine in moderate therapeutic dosage (1 gm. 4 x daily) sufficient to maintain a blood level of from 3 to 5 mg. % for a period of at least 14 days or until the cornea becomes free from infiltrates and punctate epithelial staining.

f. Acute follicular conjunctivitis is characterized by sudden onset, by swelling and occasionally tenderness of the preauricular lymph nodes, and by the development, particularly in the conjunctiva of the lower lid and fornix, of numerous minute lymph follicles which give a rough,

granular appearance to the membrane. Discharge is usually scanty in contrast to the abundant discharge of other acute conjunctival inflammations.

The disease is not an etiological entity but can be subdivided into two types: (1) that caused by a filterable virus and known as inclusion conjunctivitis, and (2) that also probably caused by a virus and known as acute follicular conjunctivitis (Béal). The first type runs a course when untreated of from three months to a year but responds rapidly to sulfonamide therapy. The second type runs a course of from two to three weeks and is not affected by any known therapy. Differentiation is made on microscopic study of epithelial scrapings: cytoplasmic inclusion bodies and a polymorphonuclear cell cytology are characteristic of inclusion conjunctivitis; a mononuclear cell exudate without inclusion bodies is seen in acute follicular conjunctivitis (Béal).

Treatment: (1) Béal's conjunctivitis: No specific treatment.

(2) Inclusion conjunctivitis:

(a) Sulfanilamide or sulfadiazine in moderate dosage (3 to 4 gms. daily) for seven days.

(b) Local sulfonamide therapy, in the form of 5% sulfathiazole ointment q.i.d., may be used as a supplement.

g. Epidemic keratoconjunctivitis, a disease endemic in India and the Far East, first reached the United States in 1941, becoming epidemic on the West Coast and later spreading to other parts of the country. At onset it resembles acute follicular conjunctivitis but is usually more severe, some 25% of cases having transient pseudomembranes. The keratitis, consisting of grossly visible punctate subepithelial infiltrates having a tendency to group in the pupillary area, develops 7 to 10 days after onset. The disease is caused by a filterable virus and is highly communicable, as shown by its spread among shipyard workers on the Pacific Coast. Accidental transmission by physicians and nurses is believed to have occurred. Diagnosis is made on the characteristic appearance of the corneal lesions.

Treatment: No effective treatment is known at the present time. Convalescent antiserum given early is believed to modify the severity of the corneal lesions. Although spontaneous healing always occurs after periods varying from three weeks to several months, vision is frequently impaired.

Medical officers should be vigilant in detecting early cases of this disease which must be isolated immediately. Meticulous care should be taken to prevent transmission through contaminated droppers, tonometers, solutions, hands, etc., since the virus seems to be able to survive drying, dilution, and aging.

h. Allergic conjunctivitis of two types is commonly observed: (1) A simple inflammation of the conjunctiva typified by hay fever conjunctivitis in which the main characteristics are intense itching, edema, and hyperemia, with numerous eosinophils in the secretion; (2) an inflammation typified by atropine conjunctivitis and complicated by an associated contact dermatitis of the eyelids and by a relatively intense cellular infiltration of the conjunctiva. The shock tissue is presumably the capillary bed of the conjunctiva in the first type and the epithelium of the conjunctiva and lids in the second.

Treatment: (1) Identification and elimination of the causal substances, most commonly air borne agents such as pollens in the hay fever type, or a local medication or cosmetic in the atropine type.

(2) Local therapy is purely for the temporary relief of symptoms and consists in medication which will constrict the conjunctival capillary bed; cold packs, cold boric acid irrigations, adrenalin hydrochloride 1 to 4,000 solution, or 1/2% ephedrine sulfate solution are recommended.

i. Vernal catarrh is believed to be a special form of conjunctival allergy in which specific sensitivity is difficult and often impossible to determine. It is characterized by its onset in early spring and disappearance in late fall and by its affinity, in the form of papillary excresences, for the upper tarsal and limbal regions. It is always aggravated by hot weather and relieved by cold. Diagnosis is made on the basis of the pavement block-like papillae of the upper tarsus combined with intense itching and history of seasonal occurrence. Numerous eosinophils are found in conjunctival smears.

Treatment, consisting in the frequent use of such vasoconstrictor drops as were recommended for allergic conjunctivitis, is purely palliative. The disease tends to disappear after a course of from five to seven years. In military life, particularly in the tropics, vernal catarrh may become disabling due to the intense itching and to the stringy secretion which blurs the vision.

4. CORNEA.

a. Abrasions of the cornea are accompanied by discomfort, which may be referred to the upper lid, and by lacrimation, photophobia, and foreign-body sensation. For diagnosis, instill 2% butyn sulfate solution three times and wait five minutes. Then instill one drop of 2% fluorescein or 2% aqueous mercurochrome solution and wash out with boric acid solution or saline. Any break in the corneal epithelium will stain green with the fluorescein or red with the mercurochrome.

Treatment: Instillation of 5% sulfathiazole (ophthalmic) ointment, or 1 to 5,000 merthiolate ointment, and pressure dressing for twenty-four hours. Inspect and repeat until healed.

b. Corneal ulcer in its early stages is similar to corneal abrasion in symptoms and appearance but the onset is not precipitous and discomfort increases as the ulcer progresses. The corneal defect has a greyish appearance due to necrotic material and infiltration with leucocytes. An infected abrasion usually develops into an ulcer. Marginal ulcers are usually benign but central ulcers are always potentially serious and should be hospitalized.

Treatment of marginal ulcers: (1) Hot compresses.

(2) Instillation of an antiseptic ointment such as 5% sulfathiazole (ophthalmic) or 1-5,000 merthiolate ointment every two hours after hot compresses.

(3) Treatment of associated blepharitis and conjunctivitis if present.

(4) Aspirin or APC tablets for relief of pain.

(5) 2% homatropine or 1% atropine sulfate solution if iris irritation develops as manifested by severe photophobia.

(6) Dark glasses should be worn between treatments. Do not apply a dressing.

Central ulcers require bacteriological study and local or parenteral sulfonamide or penicillin therapy according to the type of infecting organism. Penicillin drops may be made up by dissolving 800 to 1000 units per cc. of sterile water or normal saline. One drop should be instilled every half hour.

c. Foreign bodies give symptoms of discomfort, which may be referred to the upper lid, and of lacrimation and photophobia. Usually there is a history of getting something into the eye. Foreign bodies may best be viewed through a condensing lens by means of focal light shone obliquely across the cornea. The ophthalmoscope, fitted with the plus 20 lens, may also be used.

Treatment: (1) Instill a local anesthetic such as butyn solution 2% three times and wait five minutes.

(2) Brush a moist cotton applicator lightly across the foreign body in an attempt to dislodge it. If it does not come away, brush more firmly with pressure. If it is not all removed, place the point of a surgically clean eye spud or knife on the cornea at the edge of the foreign body. Dig the blade gently behind it and try to lift it out. If it is fragmented or a rust stain remains, curette lightly with the tip of the spud or a dental burr to remove all the fragments.

(3) Instill 5% sulfathiazole or metaphen or merthiolate ophthalmic ointment.

(4) If a spud was used, apply a pressure dressing for twenty-four hours.

(5) Reexamine and reapply the dressing until the cornea is healed.

A mydriatic (atropine or homatropine) is not necessary in uncomplicated corneal or conjunctival foreign body cases and should not be instilled.

It is inadvisable to allow the patient to instill local anesthetics at his own discretion for the relief of ocular discomfort. Anesthesia suppresses the normal protective reflexes of the eye and at the same time retards healing. Serious corneal ulcers may develop during prolonged use of local anesthetics. In general, severe discomfort from injuries to the eye can best be controlled by immobilization of the eyes with a double eye dressing and an analgesic drug such as aspirin and codeine in combination.

d. Multiple foreign particles such as fine glass, powder, emory, and debris are sometimes driven into the cornea.

Treatment: (1) Instill 2% butyn or 1/2% pontocaine solution and irrigate every twelve hours with boric acid solution rather than attempt immediate removal with a spud.

(2) Instill sulfathiazole ointment and apply a light dressing between treatments.

(3) After a few days the particles tend to extrude and should then be removed with a cotton applicator or eye spud.

e. Pterygium is the encroachment on the cornea by a new growth from the conjunctiva, either nasally or temporally. It is impossible to determine by the appearance of the growth whether it is progressive or stationary. History of or actual observation of progression is the only criterion.

Treatment: If there is less than 3 mm. extension onto the cornea, no treatment is required. If there is more, hospitalize for surgical removal.

SECTION IV. DISORDERS OF THE INTERNAL EYE.

1. UVEAL TRACT.

Uveitis is inflammation of the vascular coat which lies between the sclera and the retina. This includes the iris, ciliary body, and choroid, and inflammations of these parts are designated specifically as iritis, cyclitis, or choroiditis. Uveitis is the more inclusive term indicating the anatomical and pathological continuity of the tract.

The great vascularity of the uvea has been considered the reason for its susceptibility to circulating toxins. Foci of infection (teeth, tonsils, sinuses, and prostate), colitis, arthritis, and such granulomatous diseases as tuberculosis, syphilis, undulant fever, and Boeck's sarcoid, are known to be associated with uveitis in specific cases and if present are considered likely causes. In old age, degenerative conditions, often vascular in origin, arising within the eye itself, frequently set up inflammation in the uveal tract.

Acute inflammation of the iris or ciliary body is usually manifested by moderate or severe ocular pain, ciliary congestion (circumcorneal redness), contracted pupil, blurred vision, photophobia, and normal to low intraocular tension. Examination with oblique focal illumination frequently reveals an exudate in the anterior chamber, a swollen, muddy-looking iris, adhesions between the pupillary edge of the iris and the lens, and dilated vessels on the iris. In chronic cases the congestion and pain are slight or absent and diminution of vision is the presenting symptom. Iris adhesions and small punctate deposits known as keratic precipitates ("K.P.", i.e., leucocytes and pigment), which are best seen with the plus twenty lens in the ophthalmoscope, are the diagnostic signs.

In acute or chronic choroiditis there frequently is no evidence of congestion or pain, and the presenting symptom is disturbance of vision from vitreous opacities (floaters or "mother of vinegar" opacities in the vitreous). These can be seen readily with a plus 5 to 12 lens in the ophthalmoscope. If the pupil is dilated and the patient looks up and down, the opacities are seen moving about. The inflammation appears in the fundus as a greyish or white area. As this heals there is pigment proliferation and the final appearance is that of a white area mottled irregularly with pigment.

Treatment:

a. Emergency: (1) Dilation of the pupil with atropine to put the iris and ciliary body at rest and prevent adhesion of the iris to the lens.

(2) Hot compresses, salicylates, and codeine to control the pain.

(3) Dark glasses for comfort.

b. Definitive: (1) Hospitalization for survey to determine cause.

(2) Treatment of causative factors.

(3) Hyperthermia.

2. LENS.

Cataract is an opacification of the lens due to a number of causes among which intraocular inflammation and injury are of particular military importance. Principal symptoms are diminished vision and dazzling. The cataract is seen, preferably with the condensing lens, as a white or grey opacity of the pupil. On ophthalmoscopic examination the normal red fundus reflex is absent or diminished and the interior of the eye cannot be seen.

Treatment: Cataract denotes serious intraocular pathology which must be studied in detail to determine whether or not surgical measures are indicated.

3. RETINA AND OPTIC NERVE.

a. Retinitis is an inflammatory condition involving the visual-sensory layer or inner coat of the eye and is almost always associated with inflammation of the underlying choroid. It should be distinguished from the retinopathies arising from circulatory disturbances in general diseases such

as diabetes, nephritis, leukemia, hypertension, and arteriosclerosis. The etiology, symptoms, and treatment of retinitis are in most cases identical with those of choroiditis.

b. Retinal detachment is a separation of the retina from the underlying choroid to which it is normally adherent. Trauma, inflammations, degenerations such as occur in high myopia, and choroidal tumors are the most frequent causes of the separation. Symptoms consist in diminished vision and in defects in the visual fields corresponding to the detached area. With the ophthalmoscope the detached retina is seen usually as an elevated membrane of wavy contour and translucent or greyish in color. The vessels in the detached area look darker than they do normally.

Treatment: (1) Double eye bandage to immobilize the eyes.

(2) Immediate hospitalization for surgical treatment.

c. Papilledema or choked disc is an edema of the nerve head which results in elevation, blurring of the disc margins, and sometimes hemorrhages. Typically the retinal veins are dilated, the vision well preserved. Papilledema is caused most often by increased intracranial pressure and its presence is an indication for immediate hospitalization and neurological study.

d. Optic neuritis or papillitis, in contrast to papilledema, is an inflammatory swelling of the nerve head characterized by early and marked reduction in vision. Pain on motion of the eyeball is frequently a symptom. Etiology is often obscure but syphilis and multiple sclerosis are common causes. All cases should be hospitalized for studies similar to those required for uveitis.

4. GLAUCOMA.

Glaucoma is a symptom complex characterized by increased intraocular pressure. This pressure causes damage to ocular structures, particularly the optic nerve. Glaucoma may be secondary to such eye pathology as inflammation, tumor, hemorrhage, or injury, or it may be primary, i.e., with no demonstrable cause for the increased pressure. The examiner can determine an increase in pressure by palpating his own eye (looking down) through the lid with the two index fingers, and then the eye of the patient (who is asked to look down), and comparing the feeling of resistance. Tonometers are used for the quanitiative determination of intraocular pressure.

a. Acute glaucoma is accompanied by severe ocular pain, ciliary congestion, dilated fixed pupil, a steamy hazy cornea, and blurred vision. If the tension remains high the retina and optic nerve are damaged and irreparable loss of vision can occur within twenty-four hours. At onset the pressure may be so high as to stimulate the vagus nerve, producing nausea and vomiting.

Treatment: (1) Immediate instillation of miotics, such as 2% pilocarpine or 1/4% eserine, repeated every hour until the pressure is reduced and the pupil contracted. Miotic drops should then be instilled at least three times a day until hospitalization.

(2) Ice packs, codeine, and aspirin for reducing pain. Morphine is particularly useful when the pain is severe as it tends to contract the pupil while allaying pain.

(3) Hospitalization for definitive treatment, surgical and otherwise.

b. Chronic glaucoma is the result of a gradual increase in tension, the eye having time to compensate for it. Pain and congestion are frequently absent, the pathognomonic findings being a cupped optic nervehead and characteristic defects in the visual fields. Normal physiological cupping of a degree that may arouse suspicion is frequently seen but does not extend to the edge of the disc and is unaccompanied by increased tension or field defect. In pathological cupping, or excavation of the nerve head, the cup invariably extends to the edge of the disc.

Treatment: (1) Control of tension by miotics or surgery to an extent that no further loss of field occurs.

(2) Hospitalization for intensive tension and field studies.

(3) Frequent tension and field studies as long as the patient lives.

SECTION V. OCULAR BURNS AND INJURIES.

1. OCULAR BURNS.

a. Eyelid burns of any degree should be treated liberally with 5% sulfathiazole (ophthalmic) ointment, or 10% boric acid ointment, and covered with light gauze. If of first degree only, repeat every twenty-four hours until healed. If deeper than first degree, hospitalize. If the eyelid burn is accompanied by other burns requiring oral sulfonamide therapy, sulfathiazole ointment should be omitted.

b. Conjunctival and corneal burns should receive three instillations of 1/2% pontocaine or 2% butyn solution, and irrigations with boric acid solution. Instill 5% sulfathiazole or merthiolate or metaphen (ophthalmic) ointment twice daily. Apply light dressing and repeat in twelve hours. If the burn is more than superficial or if healing is slow, hospitalize.

c. When the lids, conjunctiva, and cornea are all involved, first consideration should be given the cornea. If the cornea, whether burned or not, is exposed by reason of retraction of the lids it should be coated constantly with ointment and covered with a protective shield of the Buller's type. A Buller's shield can be made by cutting a 4-inch diameter disk of x-ray film, making a cut to the center from the edge, overlapping the cut edges, and fastening them with adhesive tape to form a low cone. This is rimmed with adhesive tape and placed over the eye. Additional strips of adhesive will hold the shield securely.

d. Chemical burns should receive immediate, copious irrigations with water. Evert the lids and flush a pint or more of water into the conjunctival sac and over the cornea. For alkali burns, 1% acetic acid solution for purposes of neutralization may be used to advantage.

In acid burns there is no penetration of the acid beyond the depth of the visibly burned areas as the acid immediately coagulates the protein superficially, preventing deeper extension of the burn. Alkali burns have a delayed and prolonged reaction due to penetration of the alkali into the tissue substance beyond the visibly burned area. For alkali burns, therefore, continue irrigation with acetic acid every half hour for the first day. Make certain that any solid particles such as bits of lime are removed from the fornices.

Follow irrigation with instillation of 5% sulfathiazole ointment or 1-5,000 merthiolate ointment. Bland ointments and oils such as boric acid ointment or castor oil may be used if antiseptic ointments are not available.

e. Poision gas burns. Immediately after the eye has been contaminated by any liquid blister gas, either Mustard, Nitrogen Mustards or Lewisite, or mixtures thereof, Bal Eye Ointment is squeezed directly into the lower conjunctival sac. The eye is then massaged for one minute. This is followed by irrigation with water from the canteen or other uncontaminated source. The water should be poured directly, slowly, and continuously into the eye for at least 30 seconds but not longer than two minutes. An antiseptic ointment such as 5% sulfathiazole or 1 to 5,000 merthiolate should next be instilled. If Bal eye ointment is not immediately available the eye should be irrigated as early as possible regardless. Bal ointment placed in an uncontaminated eye is quite irritating and may produce sufficient blepharospasm to interfere with the individual's combat ability for at least fifteen minutes. It should, therefore, be used in the eye only when the individual is fairly certain that his eye has been contaminated by liquid blister gas.

The lids, lashes, and skin areas adjacent to the eyes are best decontaminated by washing with soap and water.

Eye burns from field concentrations of vapor are unlikely and no decontamination or treatment is necessary following exposure unless obvious pain or irritation results. This can be relieved by irrigation with water followed by the instillation of eye and nose drops (Med. Dept. item No. 9109100).

All individuals with burns resulting from liquid vesicants should reveive immediate hospital care in order to prevent complications due to secondary infection.

Vapors of lacrimator gases produce a marked but self limited conjunctivitis for which no treatment is necessary. Liquid lacrimators when splashed into the eyes are corrosive and produce burns resembling strong acids. The eye should be flushed immediately with water following

which an instillation of 1/4% sodium sulfite is used. Eye pain may be relieved by instilling eye and nose drops (Med. Dept. item No. 9109100).

The lung irritant gases produce only mild conjunctival irritation. Irrigation with water followed by the instillation of eye and nose drops is the only treatment needed.

For complete information regarding the fundamentals of the treatment of poison gas casualties the medical officer is referred to TM 8-285, April 1945.

2. ACUTE EYE INJURIES.

a. Perforating wounds of the cornea and sclera in all cases should receive hospital care by an ophthalmological consultant. Prophylactic chemotherapy (4 gms. sulfadiazine daily) should be started at once. Great care must be taken to avoid pressure on the globe which might increase the prolapse and lead to dislocation of the lens and loss of vitreous. The instillation of an antiseptic ointment (1-5,000 merthiolate or 5% sulfathiazole ointment) and the protection of the eye with a sterile dressing should be the only immediate first aid care. A double dressing immobilizing both eyes affords the best protection to the injured eye.

Definitive care consists in the replacement of prolapse if possible or, if not possible, excision. The wound should be closed with 000000 silk sutures on atraumatic needles. Only exceptionally does a wound require covering with a sliding conjunctival flap. When a wound is so destructive that preservation of the eye is impossible, enucleation is indicated with implantation of a gold or glass sphere in Tenon's space.

After any repair of the cornea or sclera the eye should be watched carefully for such signs as continuing pain, photophobia, and irritation which might indicate developing sympathetic ophthalmia. A continued unfavorable course may necessitate enucleation.

b. Retained intraocular foreign bodies necessitate immediate hospitalization of the patient. The foreign body should be localized accurately by x-ray. A careful history will usually indicate the nature of the foreign body, but a test with the electromagnet should be made in every case nevertheless. If magnetic, immediate removal is indicated. If removal is effected by the posterior route, diathermy coagulation should be employed around the wound in an effort to prevent late retinal detachment.

Except for copper-containing bodies which produce degeneration of the eye due to chalcosis, non-magnetic bodies, unless reasonable accessible, should be left in situ, particularly if they are known to be of inert material.

c. Laceration of the lid through its entire thickness is serious and should be repaired by an ophthalmological consultant; notching and other gross deformities frequently result from unskilled care. Avulsion of the nasal end of the lower lid is particularly serious since the lower canaliculus is severed and annoying epiphora will result unless adequate repair is made. In any severe laceration of the lid the cornea must be protected to avoid ulceration due to dessication or trauma while definitive therapy is awaited. This protection can be by means of a light dressing if the lids are closed, or by means of a Buller's shield when closure of the lids is impossible.

d. Contusions or blows about the orbit may injure the lids, orbital walls, or globe. As the damage may be more or less than is suspected from the immediate appearance, all such cases should be examined in detail. Extensive ecchymosis is often seen in connection with insignificant ocular injury or, on the other hand, it may involve both eyes following a head injury and constitute a sign of basal skull fracture. In this case the extravasation of blood into the orbit gives a different picture from that following ecchymosis from a direct blow to the region; there is less swelling or other indication of injury unless, of course, the blow producing the fracture struck the orbit directly.

The examiner should palpate the lids gently, feeling for crepitus resulting from fracture into the sinuses, usually the ethmoid, which allows air to excape into the tissues. In such cases blowing the nose can force increasing amounts of air into the lids so that considerable swelling follows. Orbital iniection from the sinuses may be a resultant complication. The orbital rim should be palpated carefully for evidence of abnormal contours and points of tenderness. Subsequent swelling may obscure signs and make examination difficult, so it is important to obtain as much information as possible at the original inspection. The eyeball should be examined carefully, the

lids being retracted, if necessary, with Desmarres lid retractors or strabismus hooks. The vision should be recorded, the position of the globe noted, and tests made for limitation of rotation in any direction of gaze. The cornea, anterior chamber, and iris should be examined with oblique focal illumination to determine any haziness, corneal abrasion, hemorrhage into the anterior chamber (hyphema), or pupil irregularity. The pupil is often dilated and frequently a small dialysis at the root of the iris accompanies even a minor blow. The pupillary reflex should be checked. The media and fundus should then be examined with an ophthalmoscope. The transparency of the media may be clouded by blood. The retina may show edema or tears at the posterior pole due to "contre coup" force. Finally, the orbital region should be x-rayed although fracture is often not recognized unless special techniques are used. Fracture of the orbital floor, particularly, is often overlooked, both in the x-ray picture and clinically, until the acute effects of the injury have worn off, when minimal depression of the globe, and subsequently diplopia, may be observed.

Treatment:

a. Simple ecchymosis:

(1) Ice packs to prevent further hemorrhage and edema.

(2) After forty-eight hours, heat, to accelerate absorption.

b. Concussion injury to globe with intraocular damage:

(1) Hospitalization.

(2) Double eye bandage for immobilization.

(3) Avoid use of atropine as tension may be elevated in such cases, the iris paralyzed, and tendency to hemorrhage increased.

(4) Codeine gr. 1 and aspirin gr. 10, by mouth, or comparable medication for pain.

c. Fractures:

(1) X-ray.

(2) Ice compresses and sedatives for comfort.

(3) Hospitalization for surgical correction of deformities.

Replacement of depressed bone is relatively easy if done early and the results in preventing diplopia and cosmetic defect justify every effort to accomplish it. As in fractures elsewhere in the body, the comfort following alignment of depressions is dramatic.

SECTION VI. DISORDERS OF THE OCULAR MUSCLES.

1. PARALYTIC STRABISMUS.

Oculomotor disturbances are rarely an emergency "per se." Cases with sudden onset usually occur in the course of a disease or an injury so serious as to be the immediate concern. Double vision, however, is sometimes the sole presenting symptom in multiple sclerosis, meningovascular lues, hemorrhage, cerebral aneurism, myasthenia gravis, thyroid disorders, increased intracranial pressure, and what may appear to be minor head injuries.

Diplopia results from faulty alignment of the eyes on the object fixed. In acute cases the deviating eye is easily demonstrated by having the patient look at a light in all positions of gaze and observing the corneal reflex of the light to note which eye is limited in motion.

Nystagmoid jerks when limited to one field suggest weakness of the muscle used in that field. This should not be confused with true nystagmus of vestibular or central origin or with searching movements of ocular nystagmus resulting from poor central vision.

Limitation of internal rotation accompanies disturbance of the internal rectus muscle; limitation of rotation down and nasally, the superior oblique; up and nasally, the inferior oblique; down and temporally, the inferior rectus; up and temporally, the superior rectus.

The 3rd nerve (oculomotor) supplies the vertical recti, internal rectus, inferior oblique, levator palpebrae which elevates the lid, and the sphincter of the iris. Consequently, in complete 3rd nerve palsy the eye would be turned out and down because the pull of the external rectus and superior oblique are unopposed, the lid would be drooped, and the pupil dilated. Partial paralyses are common with only slight droop of the lid and slight limitation of internal rotation. Multiple sclerosis and meningovascular lues characteristically affect the 3rd nerve.

The 4th nerve (trochlear) supplies the superior oblique muscle and in paresis of this nerve the eye looks down and in with difficulty and tends to deviate up and out because of the unopposed pull of the inferior oblique. This nerve is frequently involved in cases of head injury and in infections or operations on the frontal sinus.

The 6th nerve (abducens) supplies the external rectus muscle and paresis of it leads to inability to turn the eye out and a tendency for inward deviation due to an unopposed pull of the internal rectus. Paresis of this nerve is the most common type of eye muscle paralysis, for the long course of the 6th nerve from the brain stem to the external rectus muscle makes it particularly vulnerable. It is frequently impinged upon somewhere in its course if there is increased intracranial pressure stretching the dura against it. It is involved in inflammation of the tip of the petrous bone following middle ear infection, the nerve crossing this site; this involvement is known as Gradenigo's syndrome.

All cases complaining of double vision should be referred to a hospital for evaluation. Paralytic strabismus frequently recovers to a great extent and, after maximum recovery is achieved, operation procedures are very successful, the normal binocular reflexes having a strong tendency to hold the eye in proper alignment once they have been approximately aligned through surgery.

2. CONCOMITANT STRABISMUS.

The ordinary conditions of crossed or divergent eyes fall in the category of concomitant strabismus. Characteristically the deviation is the same in all fields of gaze in contrast to paralytic strabismus in which the deviation is increased in the paralytic field and diminished or absent in the unaffected field. In concomitant strabismus the patient does not experience double vision for the condition has usually been present from childhood and he has learned to suppress the image in the deviating eye. This suppression or inhibition, if constant, may persist even when the good eye is covered and the patient forced to fix with the deviating eye. Persistence of inhibition results in poor vision and is known as "amblyopia ex anopsia" or poor vision from disuse. If the eyes are used alternately the inhibition is present only when an eye is deviating; such cases usually have good vision in both eyes.

Concomitant strabismus of itself produces no symptoms. However, appreciating that they have this condition, patients frequently attribute vague symptoms of headache or ocular distress to it.

These complaints should not be entirely discounted as refractive errors are often present and can be the cause of symptoms. Once corrected, however, these cases theoretically have less reason for ocular symptoms than individuals with normal binocular reflexes, for in strabismus cases the patient pays attention to only one image which obviates the strain on the binocular reflexes to maintain alignment of the eyes. Glasses will not improve the vision in amblyopia ex anopsia unless the good eye is occluded and the refractive error corrected, forcing the patient to use the poor eye at an early age.

In the Army the chief significance of concomitant strabismus is the psychological effect it has on the victim. In many cases this is so severe as to alter the personality greatly. Surgical correction by a competent ophthalmologist may so improve the patient's mental attitude as to make him a better soldier. Care must be taken to avoid surgery in those patients with such a psychological makeup as would induce them to exaggerate post-operative symptoms as an excuse to be relieved from duties. When this seems likely a psychiatric consultation should be sought before any surgery is undertaken. On the other hand, a patient who complains of intolerable diplopia persisting for some months after operation is not to be considered neurotic. Careful examination will usually reveal overcorrection of the squint in some field of gaze or an element of vertical strabismus introduced by the operation that was not present before the surgery. Competent surgery minimizes these complications.

Head tilt in strabismus. A frequent physical finding in both paralytic and concomitant strabismus is head tilt due to a vertical muscle imbalance. Every patient showing a head tilt should have an ocular examination and medical officers must be on guard to protect the unfortunate patient whose superiors are exasperated at his inability to hold his head straight. Proper correction of the vertical imbalance eliminates the head tilt in most cases.

3. PHORIAS.

Phoria is the tendency of the eyes to deviate under conditions which interfere with the fusion mechanism, as when a red glass or a Maddox rod is placed before the eye to create dissimilar images, or the eye covered as in the cover test. Phoria to a slight degree is a normal finding. It is only when the tendency is so great that manifest strabismus is evident under conditions of fatigue, or when the binocular reflexes are strained in order to overcome phoria, that symptoms occur. These symptoms are allied to those associated with refractive errors, i.e., asthenopia, eye strain, and headache, and can usually be eliminated by correction with the proper glasses and, in rare instances, by surgery.

The cover test. The simplest and most useful means of examining oculomotor motility is the cover test. The patient is asked to fixate an object such as a flashlight held in the examiner's hand. With the other hand the examiner covers one eye or the other with a piece of cardboard and makes two observations: (1) Movement of the eye that is not covered, and (2) movement of the eye that is covered when the cover is taken away.

The first observation determines whether or not strabismus is present. For example: Cover the left eye and note the action of the right eye. If there is no movement of the right eye one can assume that it was fixating the image at the time the left eye was covered. If the right eye moves to fixate the light when the left eye is covered it obviously was not fixing before the cover was applied and strabismus was present. The direction of the movement indicates the type of squint. The process is repeated, this time the right eye being covered to determine if the left eye is fixing. Cases of minimal strabismus, not apparent as judged by corneal reflexes, can be detected in this way, and even when obvious squint exists it is sometimes difficult to tell which is the fixing eye unless this test is used. Of course, the test is not applicable if the vision is so poor that the patient will not make an effort to fix when the eye ordinarily used for fixation is covered.

If this test demonstrates that both eyes are fixating the object there is no strabismus and the second part of the cover test is then done to determine the tendency of an eye to deviate when binocular vision is interrupted (phoria) by noting the position of the eye that is covered. If the right eye is covered and then, when the cover is removed, moves to fixate the image, it must have been turned while under cover. Such movement would indicate a phoria and the direction of movement the type of phoria. Since phoria always affects both eyes, the opposite eye when covered and uncovered will respond in the same way. The test for phoria is usually performed by covering the eyes alternately, the examiner noting the movement of the eyes as the cover is moved back and forth. In exophoria the movement will be in; in esophoria, out; and in hyperphoria, up or down.

In testing for hyperphoria it is best to have the patient look to one side when the cover test is made as the vertical muscles have their greatest mechanical advantage when the eyes are turned to the side; a deficiency or overaction of the muscles is thus exaggerated in this position. To be accurate all positions of gaze should be checked during the cover test; i.e., straight ahead; to the right, up and down; and to the left, up and down.

SECTION VII. ARMY REGULATIONS AND POLICIES REGARDING EYES, CURRENTLY EFFECTIVE AS OF JULY 1945.

1. MR 1-9, 19 April 1944, Section IV.
2. Change No. 2, MR 1-9, 8 September 1944.
3. AR 40-100, 16 November 1942.
4. AR 40-105, 14 October 1942.
5. AR 40-110, 12 December 1944.
6. Change No. 1, AR 40-110, 12 April 1945.
7. WD Circular 196, 1945.
8. WD Circular 121, 1945.
9. WD Circular 113, 1945.
10. WD Circular 186, 1945.
11. WD Pamphlet 8-5, 1944.

DO NOTS IN MANAGEMENT OF EYE DISEASES

1. Do not fail to record vision in every eye injury or treatment.
2. Do not prescribe local anesthetics for continued use.
3. Do not employ sulfathiazole ointment or other sulfonamides over unnecessarily long periods.
4. Do not fail to suspect allergy in pruritic inflammations of the eye or adnexa.
5. Do not fail to incise when pointing occurs in meibomian styes to prevent the occurrence of chalazia.
6. Do not neglect to suspect the lid margins and the lacrimal apparatus as possible causes of chronic conjunctivitis.
7. Do not cover the eye in infections involving the conjunctiva or cornea.
8. Do not fail to look for gonococci or meningococci in purulent conjunctivitis.
9. Do not fail to suspect trachoma in conjunctivitis having upper tarsal follicles.
10. Do not fail to isolate suspected cases of epidemic kerato-conjunctivitis and to use all precautions to avoid transmission by fingers, solutions, or instruments.
11. Do not neglect to employ an antiseptic ointment after removal of foreign bodies.
12. Do not fail to stain the cornea for abrasions in cases with unaccountable foreign body symptoms.

SECTION VIII. LABORATORY PROCEDURES OF VALUE IN OPHTHALMOLOGY.

The following laboratory procedures are of diagnostic and therapeutic value in Ophthalmology:

I. Routine laboratory procedures.

1. Urinalysis.
2. Blood count.
3. Blood chemistry.
4. Determination of blood levels of sulfa drugs.
5. Kahn and Wasserman tests.
6. Blood culture.
7. Basal metabolic rate.

II. Special clinical laboratory procedures.

1. Bacteriologic.

A. Microscopic examinations of:

a. Secretion smears.

b. Scraping preparations.

c. Darkfield preparations.

B. Staining techniques.

a. Simple stains.

(1) Loeffler's Alkaline Methylene Blue.

(2) Safranin.

(3) Ziehl's carbol fuchsin.

b. Differential stains.

(1) Gram's stain.

(2) Wright's stain.

(3) Giemsa stain.

(4) Ziehl-Neelsen's stain.

C. Culture techniques requiring the following mediums:

a. Blood agar plates.

b. Phenol red mannitol agar.

c. Loeffler's medium.

d. Tellurite medium.

e. Chocolate agar.

f. McLeod's medium.

g. Sabouraud's medium.

h. Corper's medium.

i. Brain broth medium.

j. Thioglycollate medium.

D. Test for effectiveness of Penicillin.

E. Diagnostic animal inoculations.

a. Guinea pig.

b. Rabbit.

2. Immunologic

A. Serologic tests.

a. Widal reaction.

b. Weil-Felix reaction.

c. Brucella.

d. Tularemia.

e. Toxoplasma.

B. Skin tests.

a. Tuberculin.

b. Frei.

c. Trichinella.

d. Allergy.

3. Pathologic examinations

A. Biopsy.

B. Enucleated eye .

Indications for Laboratory Procedures

I. Routine laboratory examinations.

1. Urinalysis

A. Routine urine examination consisting of color and appearance, specific gravity, reaction, sugar and albumin should be made upon every patient admitted to an eye ward. In addition miscroscopic examination of sediment should be made when any abnormality is found in basic examination.

B. A microscopic examination and an examination for occult blood could be made whenever any abnormality is suspected in the genito-urinary tract.

C. Urinalysis should be made daily or at most every other day upon patients being treated with any of the Sulfa drugs, paying particular attention to presence or absence of Sulfa crystals and blood.

D. Urinalysis should be made upon all cases of retinopathy, patients with sudden changes in refractive error or accommodation and upon all neuro-ophthalmologic cases.

E. Urinalysis for melanin should be made in all cases of melanosarcoma.

F. Urinalysis for lead is occasionally of value in confirmation of clinical findings of chronic lead poisoning.

G. Urine cultures are of value in cases in which foci of infection are being sought.

2. Blood Count

A. A complete blood count (hemoglobin, red cell count, white cell count and differential count) should be made routinely upon all patients admitted to an eye ward.

B. Patients receiving one of the sulfa drugs should have:

a. White cell count at least every third day.

b. Differential at any time white cell count is 4,000 or below.

c. Hemoglobin at least every third day.

d. Red cell count once a week or oftener.

C. A complete blood count should be made upon cases of unexplained subconjunctival hemorrhages and all intraocular hemorrhages.

D. Differential counts should be made as an aid to the diagnosis of ocular allergies.

E. Differential counts should be made in all cases of suspected parasitic infestation (Trichina, etc).

F. Complete blood count should be made in all cases of chronic or non-inflammatory infiltrations of lids and orbit.

3. Blood Chemistry

A. Blood sugar determinations should be made upon:

a. All cases of nontraumatic presenile cataract.

b. All cases of sudden changes in refractive error and sudden loss of accommodation.

c. All cases of punctate retinal hemorrhages.

d. All cases of spontaneous vitreous hemorrhages.

e. All cases of otherwise unexplained uveal disease.

B. Sugar tolerance tests should be made in all of the above cases in which the blood sugar level is within normal limits or is equivocal.

C. Blood calcium and phosphorus determinations are of value in the differential diagnosis of presenile cataracts, particularly in the distinction of tetany cataracts.

D. Determination of blood levels of non-protein nitrogen, urea, uric acid and creatinine are of value in supporting the clinical differentiation of nephritic, hypertensive and arteriosclerotic retinopathy, and occasionally in the differentiation of a nephritic or hypertensive neuroretinopathy, papilledema and papillitis. These tests should be made in cases of acute or chronic uveitis of obscure etiology.

4. Determination of blood levels of sulfa drugs should be made at least once a week in addition to other laboratory procedures mentioned above. If large doses of the drug are being given, blood levels should be determined every other day or at most every third day.

5. Kahn and or Wasserman test should be made:

A. In all cases of nodular and ulcerative conjunctivitis.

B. In all cases simulating mucous patches of the conjuncitva.

C. In all cases of interstitial keratitis.

D. In all cases of uveal disease.

E. In all neuro-ophthalmologic cases including paresis and paralysis of intraocular and extraocular muscles, optic atrophy, and anomalous pupillary reactions.

6. Blood cultures should be made in:

A. Infections of the eye and orbit associated with a prolonged elevated temperature or a septic type of temperature.

B. Cases of endogenous (metastic) conjunctivitis.

C. Cases of spontaneous vitreous abscess.

D. Cases of dacryoadenitis.

E. Cases of tenosynovitis.

F. Cases of petechial hemorrhages of the lids and conjunctiva.

7. Basal metabolic rate should be determined:

A. In cases of exophthalmos.

B. In cases of myxedema (non-inflammatory edema of lids, partial to total loss of lashes and eyebrows, optic atrophy).

C. In cases of nontraumatic presenile cataracts.

II. Special laboratory procedures.

1. Bacteriologic

A. Secretion smears should be made in duplicate in every case of ocular inflammation in which an exudate or secretion is present, particularly in:

a. Conjunctivitis.

b. Dacryocystitis.

c. Abscess of lid or orbit.

d. Blepharitis.

e. Blepharo-conjunctivitis.

f. Kerato-conjunctivitis.

g. And when material is available from intraocular inflammatory disease.

B. Scraping preparations should be made in duplicate in:

a. Every case of conjunctival inflammation with slight or no secretion.

b. In cases of follicular conjunctivitis and trachoma in addition to secretion smears, regardless of amount of secretion.

c. Whenever possible in corneal ulcers unaccompanied by conjunctival exudate.

C. Darkfield examination should be made in every case of suspected luetic involvement of the lids and conjunctiva, and are of value in diagnosis of Vincent's infection of the conjunctiva.

D. Staining methods.

a. Simple stains are useful in determining the presence or absence of bacteria in a secretion smear or scraping but are of little diagnostic value; therefore, they are most useful as counterstains.

b. Differential stains.

(1) Gram's stain is the most useful diagnostic stain for bacteria but is of no value in cytologic studies. Gram's stain should be used on one secretion smear and or one scraping preparation from every case. In corneal cases in which only one scraping preparation can be made, Gram stain is the method of choise, ordinarily.

(2) Wright's stain is a very satisfactory, fast method of differential staining for cytologic studies of blood and tissue cells in secretion smears and scraping preparations. Most cytoplasmic inclusion bodies are demonstrable with this stain.

(3) Giemsa stain is a better but slower method of differential staining for cytologic studies and the demonstration of cytoplasmic inclusion bodies. One secretion smear and one scraping preparation from each case should be stained either by Wright's stain or Giemsa stain.

(4) Ziehl-Neelsen's stain is a differential stain for acid fast bacteria and should be used on scraping preparations from cases of suspected tuberculosis. It is also of value in corneal scrapings from cases of leprosy.

E. Cultures

a. Cultures should be made with material taken from the site of maximum pathology in all inflammatory processes of the external parts of the eye and adnexa. In addition, cultures should be made with exudate obtained from incision and drainage of inflammatory processes of the lids, orbit and adjacent structures, as well as with material obtained from intraocular inflammatory processes.

(1) Blood agar plates should be considered the standard medium for routine use, supplemented by other media in special cases.

(2) Phenol red mannitol agar plates should be used in cases of staphylococcic disease for differentiation of pathogenic and nonpathogenic staphylococci.

(3) Loeffler's medium should be used routinely in addition to blood agar plates in all cases of pseudomembranous conjunctivitis. However, diphtheritic conjunctivitis occasionally is catarrhal in character; therefore, this medium should be used routinely in cases of conjunctivitis developing in the course of diphtheritic infection of the respiratory passages. Loeffler's medium also is valuable in the isolation of the Morax-Axenfeld bacillus (Hemophilus duplex).

(4) Tellurite medium may be substituted for Loeffler's medium for the isolation of C. diphtheriae in cases of pseudomembranous conjunctivitis or diphtheritic infection.

(5) Chocolate agar is a good medium for the isolation of the Hemophilus group of organisms (influenza bacillus, Morax-Axenfeld and Koch-Weeks).

(6) McLeod's medium should be used as a supplementary medium in cases of hyperacute purulent conjunctivitis with profuse discharge as well as in all cases suspected of infection due to gonococcus or meningococcus (In these cases the culture should be incubated in an atmosphere containing ten percent carbon dioxide).

(7) Corper's medium should be used in cases of suspected tuberculosis of lids, conjunctiva and cornea.

(8) Brain broth medium for anaerobic organisms should be used in extensive wounds of the lids and orbit contaminated with dirt, etc., and in all cases of intraocular inflammation associated with the formation of bubbles of gas in the anterior chamber. In these cases the cultures should be placed in an anaerobic jar and all oxygen exhausted or replaced by hydrogen.

(9) Thioglycollate medium may be used for anaerobic organisms. It does not require the use of an anaerobic jar.

F. Test for effectiveness of Penicillin upon pure cultures of bacteria isolated from the eye is of value in chronic inflammatory processes to avoid useless medication and waste of the drug if the organism is not inhibited or killed by a concentration of five units per cc of culture.

G. Diagnostic animal inoculations.

a. Guinea pig inoculations are of diagnostic value:

(1) In cases of chronic inflammation of the eye of obscure etiology in which small biopsies may be taken from the lids or conjunctiva, or in which regional lymph nodes may be removed for biopsy and inoculation.

(2) In the differentiation of corynebacteria, to distinguish C. diphtheriae from nonpathogenic diphtheroids.

b. Rabbit cornea inoculations are of diagnostic value.

(1) In cases of corneal ulcer of obscure etiology.

(2) In vesicular disease of the conjunctiva or lids.

(3) In confirming the diagnosis of herpes corneae.

2. Immunologic

A. Serologic Tests

a. Widal, Weil-Felix, Brucella and Tularemia agglutinations should be determined in all cases of uveitis.

b. Brucella agglutinations should be determined in etiologically obscure cases of papillitis and optic atrophy.

c. Tularemia agglutinations should be determined in:

(1) All cases of ulcerative conjunctivitis, especially those with tender, enlarged preauricular lymph nodes.

(2) All cases of hemorrhagic retinopathy of obscure etiology, especially cases of periphlebitis of the retina.

d. Weil-Felix agglutinations should be determined upon all cases of hemorrhagic retinopathy of obscure etiology.

e. Toxoplasma agglutinations should be determined upon all cases of uveitis of obscure etiology, particularly the macular and perimacular nodular types.

B. Skin Tests

a. Tuberculin tests should be made (only after a complete physical examination including X-ray examination of the chest has failed to reveal evidence of active tuberculous disease elsewhere in the body) in cases of:

(1) Ulcerative conjunctivitis after other methods of diagnosis have been exhausted.

(2) Nonulcerating corneal disease characterized by the development of interstitial infiltrates and opacities with or without vascularization (after other diagnostic procedures have failed).

(3) Iritis and anterior uveitis characterized by the formation of lardaceous or mutton fat deposits on posterior surface of cornea.

(4) Scleritis.

(5) Posterior uveal disease after other diagnostic procedures have failed to reveal the etiology.

(6) Phlyctenular disease of the conjunctiva and cornea.

(7) Periphlebitis of the retina after other diagnostic procedures have been exhausted.

(8) Opticochiasmatic arachnoiditis.

b. Frei test should be made in cases of ulcerative conjunctivitis, or ulcers of the lid associated with preauricular lympadenopathy.

c. Trichinella skin test is of value in cases of trichinosis. The ocular manifestations include edema of conjunctiva, with or without edema of lids and face, pain upon ocular rotation, and conjunctival eosinophilia; differential blood count usually shows an eosinophilia of 8% to 20%.

d. Allergy Tests

(1) Scratch tests or intradermal tests are indicated in cases of:

(a) Simple allergic conjunctivitis.

(b) Vernal conjunctivitis.

(c) Ocular migraine of obscure etiology.

(2) Patch tests are of value in determining the offending agents in contact types of sensitivity of the lids, conjunctiva and cornea.

(3) The conjunctival test for allergy or contact sensitivity occasionally is useful after other allergy tests have failed, but should be used with caution and only in an uninflamed eye.

3. Pathologic Examinations

A. Should be made upon all tissues excised from the eye and adnexa.

B. Should be made upon all enucleated eyes.

C. Biopsies should be made only after all other methods of diagnosis have failed to reveal the etiology of inflammatory lesions.

D. Small tumors of the lids and conjunctiva should be excised completely.

Clinical Laboratory Techniques

The following notes on clinical laboratory techniques are intended primarily to enable the Ophthalmologist to supply the laboratory with material in a condition in which the technician or laboratory officer can utilize the specimen to best advantage. Secondarily they are intended to enable the Ophthalmologist to indicate to laboratory personnel techniques which are peculiar to ophthalmic practice or which have to be altered somewhat from ordinary laboratory procedures. And finally they are intended to aid the Ophthalmologist in interpreting the results.

For complete details of techniques not described below see:

1. Simmons and Gentzko: Laboratory Methods of the United States Army, Fifth Edition, Lea & Febiger, Philadelphia, 1944.

2. War Department Technical Manual 8-227, Methods for Laboratory Technicians.

I. Routine laboratory procedures.

1. Urinalysis.

A. Urine ordinarily should be collected in a clean container as the first morning sample which should be delivered to the laboratory as soon as possible.

B. Melanuria may occur in cases of melanosarcoma but not always. The urine may darken upon exposure to air, assuming a dark brown or black color.

a. Tests for Melanin:

(1) The addition of a few drops of ferric chloride solution to 10cc of urine gives a gray precipitate which blackens on standing.

(2) Bromine water added to urine in equal proportions causes a yellow precipitate which gradually turns black.

b. Caution:

(1) Salicylates, salol, aspirin and similar drugs should not be given for at least twenty-four hours before the urine specimen is obtained for either of these tests.

C. Urine cultures must be made only from catheterized specimen obtained aseptically.

2. Blood Count (See U. S. Army Laboratory Manuals).

3. Blood Chemistry.

A. Blood for chemical analysis is drawn aseptically by vein puncture with a sterile, dry 10cc or 20cc syringe fitted with a sterile, dry 20 gauge needle 1.5 inches long. The blood is immediately transferred to sterile containers and sealed for transportation to the laboratory. In some of the tests anticoagulants are required and in some they are contraindicated. Therefore, the following table shows the volume of blood required, the type of anticoagulant required and the tests in which they are contraindicated:-

Test	cc of blood required	Anticoagulant*	Normal Value per 100cc
Non-protein nitrogen	5	Sodium or Potassium	25-30 mg
Urea nitrogen	5	Oxalate	12-15 mg

Test	cc of blood required	Anticoagulant*	Normal Value per 100cc
Creatinine	5	Potassium	1-2 mg
Uric Acid	5		2-4 mg
Blood sugar	5	Ammonium	80-120 mg
Chlorides	5		450-500 mg (whole blood)
		Oxalate	550-650 mg (plasma)
Sulfa levels	5		.00 mg
Cholesterol	5	Mixture	150-230 mg
Phosphorous	10	None	3.7-5 mg
Phosphatase	10	None	1.5-4 Bodansky Units (Adults) 5-12 Bodansky Units (Children)
Calcium	10	None	10-12 mg
Total protein	10	None	6.5-8 g
Albumin-Globulin ratio	10	None	1.7/1-3/1
Wasserman	8-10	None	-
Kahn	5	None	-

*Anticoagulants:-

Best results with anticoagulants are obtained by having the dry salts in the container before the blood is drawn. Upon transferring the blood from the syringe to the specimen container, the bottle or tube is gently rotated between the hands until the salt is thoroughly mixed and dissolved. The most efficient method of preparing containers with anticoagulants is to place measured amounts of solutions in the container and dry them as follows:

Potassium or Sodium Citrate:

1. Place 0.1cc of 10% solution in specimen bottle or tube.
2. Dry in oven at not over 80° Centigrade.
3. Resulting 10mg is sufficient for 5cc of blood.

Potassium Ammonium Oxalate Mixture:

1. Place 0.5cc of following solution in specimen bottle.
   Potassium Oxalate 2.0 g
   Ammonium Oxalate 6.0 g
   Distilled Water 250.0 cc
2. Dry in oven at not over 70° Centigrade.
3. Resulting salt mixture is sufficient for 5cc of blood.

4. Blood sulfa levels - See section and table immediately above.
5. Wasserman and Kahn - See section and table above.
6. Blood Culture.
   A. Materials required.
      a. Culture medium (500cc flask containing 150-200cc nutrient broth)
      b. One dry sterile 10cc or 20cc syringe.

c. One dry sterile 20 gauge needle 1 1/2" long.

d. Alcohol lamp or bunsen burner.

e. Tourniquet.

f. Tincture of iodine.

g. 70% alcohol.

h. Sterile sponges.

B. Technique

a. Place tourniquet on arm

b. Prepare site of puncture with tincture of iodine.

c. Remove iodine with alcohol sponge.

d. Dry site of puncture with sterile sponge.

e. Puncture vein withdrawing 10cc of blood.

f. Remove tourniquet.

g. Withdraw needle.

h. Remove cotton plug from flask and flame mouth.

i. Introduce blood without touching needle to mouth of flask.

j. Flame mouth of flask and reinsert plug.

k. Mix blood and medium by gentle rotation of flask.

l. Place flask in incubator as soon as possible.

C. Remarks

a. Best results are obtained by having medium warmed to 37° Centigrade at time of introduction of blood.

7. Basal Metabolic Rate.

A. Patient should be hospitalized the day before the test.

B. The evening before the test the patient should have a bland diet. Stimulants and gas forming foods should be avoided. The patient should have no food nor tobacco after the evening meal and nothing by mouth from midnight until after the test.

C. Medications should be avoided until after the test.

D. Patient should remain at bed rest until after the test.

II. Bacteriologic.

1. Preparation of Secretion Smear.

A. Materials required.

a. Platinum loop or platinum spatula (spatula preferred).

b. Alcohol lamp or bunsen burner.

c. Clean glass slide.

B. Technique

a. Heat loop or spatula in flame until red hot.

b. Allow to cool.

c. Pick up secretion in loop or spatula.

d. Spread the material evenly and thinly upon a clean glass slide and allow to dry.

e. Flame the loop or spatula.

C. Remarks

a. Local anesthesia is not required for making secretion smears from the conjunctiva.

b. In making secretion smears from the conjunctiva, evert the lower lid and pick up the secretion in lower fornix; however, if secretion is slight a sufficient amount for two smears usually can be obtained in the region of the caruncle or inner canthus.

c. Secretion smears may be made in a similar manner after the incision of a lid abscess, hordeolum, acute chalazion, from the lid margins, or material expressed from the puncta in a case of dacryocystitis.

d. Secretion smears may be made from material expressed from the meibomian glands but the lid margin should be cleansed before the expression.

e. A loopful of sterile saline placed on the slide frequently permits better and more uniform spreading of the material. This is valuable in cases of scanty, thick, sticky or tenacious secretions.

2. Preparation of Conjunctival Scraping.

A. Materials required.

a. Platinum spatula.

b. Alcohol lamp or bunsen burner.

c. Clean glass slide.

d. Local anesthetic.

B. Technique

a. Anesthetize the conjunctiva (Instill local anesthetic one drop at a time at intervals of one minute until three or four drops have been used. Anesthetics: 5% Cocaine or 2% Butyn)

b. Heat the spatula in the flame until red hot.

c. Allow to cool.

d. Draw the spatula lightly and quickly across the conjunctiva four or five times. Hold the spatula vertical to the conjunctiva or with the handle inclined slightly in the direction of the stroke.

e. Spread the material thinly and evenly on a clean glass slide.

f. Flame the spatula.

C. Remarks

a. Scraping should be taken from the site of maximum conjunctival pathology. For example, in trachoma the greatest amount of conjunctival pathology usually is near the superior border of the upper tarsus and in the upper fornix; whereas, in inclusion blennorrhea the greatest amount of pathology is usually in the lower tarsal conjunctiva and lower fornix; and in an early catarrhal conjunctivitis the greatest pathology usually is in the lower bulbar conjunctiva and lower fornix.

b. Two scrapings should be taken. One should be stained by Gram's method and one stained with either Wright's or Giemsa's stain.

c. Scrapings should be taken by the Ophthalmologist or a specially trained technician.

3. Preparation of Corneal Scraping.

A. Materials required.

a. Same as for conjunctival scraping except that a sterile Graefe knife may be used instead of the spatula.

B. Technique

a. Anesthetize cornea (use five drops of local anesthetic).

b. Sterilize spatula in flame (dry heat sterilized Graefe knife may be substituted).

c. Scrape small amount of material from cornea (take as little as possible to avoid corneal scarring).

d. Spread evenly and thinly upon glass slide.

e. Flame spatula.

C. Remarks

a. Corneal scraping should be made only by an Ophthalmologist.

b. Usually only enough material for one slide may be obtained and in that case Gram's stain ordinarily is preferable.

4. Darkfield Method

A. Materials required.

a. Microscope.

b. Special darkfield condenser.

c. "Funnel stop" for objective.

d. Light source.

e. Clean slides 1.45mm to 1.55mm in thickness.

f. Cover slip.

g. Vaseline.

h. Cedar oil.

B. Adjustment of microscope and light.

a. Remove ordinary condenser and insert darkfield condenser with its two lateral adjustment screws forward.

b. Adjust the source of light until a bright ring or spot appears on upper surface of condenser.

c. With the low power objective locate the tops of the condenser and the concentric ring.

d. Manipulate lateral adjustment screws until the ring appears directly in the center of the field.

e. Remove the oil immersion objective, unscrew the lens and insert the funnel stop with its small end toward the lens.

f. Replace the objective in its original position.

C. Examination.

a. Place small drop of secretion on center of slide.

b. Gently press cover slip over this, avoiding bubbles.

c. Ring cover slip with vaseline.

d. Lower substage and place a drop of thin cedar oil, free of bubbles, on upper surface of condenser.

e. Put slide preparation on mechanical stage and center.

f. Raise substage until oil is spread by contact with the slide, filling space between slide and condenser.

g. Place drop of cedar oil on cover slip.

h. Lower oil objective and focus.

i. Micro-organisms should appear as bright objects against a black background.

D. Remarks

a. Primary and secondary leutic lesions contain large numbers of treponema. Serum from the deeper portions of the lesion contains more spirochetes and are rarely accompanied by secondary surface contaminants. The surface is cleansed and gently scraped with a curette or rubbed briskly with gauze to produce an exudation of serum. This may be hastened by gently squeezing or by suction with a glass tube provided with a rubber nipple. Bleeding should be avoided although a few red blood cells will not interfere with the examination.

b. When only a small drop of serum can be obtained this should be placed on the slide and a loopful of sterile saline added.

c. Conjunctival secretion or material obtained by gentle scraping of the conjunctiva and suspended in saline usually contains large numbers of spirochetes in Vincent's infection of the conjunctiva.

5. Staining techniques

A. Simple stains

a. Loeffler's Alkaline Methylene Blue

Materials

(1) Solution A
Methylene blue (90% dye content) 0.3 g
Ethyl alcohol, 95% 30.0 cc

(2) Solution B
Dilute KOH (0.01% by weight) 100.0 cc

(3) Solution C
Mix solutions A and B

Technique

(1) Dry smear in air.

(2) Fix in flame (pass slide quickly through flame twice).

(3) Cover slide with solution C for fifteen to thirty seconds.

(4) Wash with distilled water.

(5) Dry in air and examine.

Remarks

(1) All structures stain blue.

(2) This stain gives good morphological definition of bacteria.

b. Safranin

Materials

(1) Safranin staining solution
Safranin (saturated solution in 95% alcohol) 10cc
Distilled water 100cc

Technique

(1) Dry smear in air.

(2) Fix in flame.

(3) Cover slide with staining solution for ten seconds.

(4) Wash with distilled water.

(5) Dry in air and examine.

Remarks

(1) All structures stain red.

c. Ziehl's carbol fuchsin

Materials

(1) Solution A (stock solution)
Basic fuchsin (90% dye content) 0.3g
Ethyl alcohol, 95% 10.0cc

(2) Solution B (stock solution)
Phenol 5.0g
Distilled water 95.0cc

(3) Solution C (staining solution)

Solution A	1 part
Solution B	9 parts

Technique

(1) Dry smear in air.

(2) Fix in flame.

(3) Cover slide with staining solution for sixty seconds.

(4) Wash with distilled water.

(5) Dry in air and examine.

Remarks

(1) All structures stain red.

B. Differential stains.

a. Gram stain (Hucker Modification)

Materials

(1) Solution A (crystal violet stock solution)

Crystal violet (85% dye content)	4.0g
Ethyl alcohol, 95%	20.0cc

(2) Solution B (ammonium oxalate stock solution)

Ammonium oxalate	0.8g
Water	80.0cc

(3) Solution C (staining solution)

Solution A	1 part
Solution B	4 parts

(4) Gram's Iodine Solution

Iodine	1.0g
Potassium Iodide	2.0g
Water	300.0cc

(5) Decolorizing Solution
Ethyl alcohol, 95%

(6) Counterstain

Safranin (saturated solution in 95% alcohol)	10.0cc
Water	100.0cc

Technique

(1) Fix smear in flame. (Pass slide quickly through flame twice).

(2) Stain one minute with Solution C.

(3) Wash with water.

(4) Apply iodine solution one minute.

(5) Decolorize in 95% alcohol fifteen to thirty seconds.

(6) Counterstain with safranin ten seconds.

(7) Wash, blot dry and examine.

Remarks

(1) Solution C is relatively unstable, therefore should be mixed in small quantities and made up fresh each day. The other solutions are stable.

(2) Organisms taking blue stain are Gram positive.

(3) Organisms taking red stain are Gram negative.

(4) Staining technique may be checked by adding smear of tartar from teeth at one end of slide. If the technique is satisfactory both Gram positive and Gram negative organisms will be found in this smear.

b. Wright's stain

Materials

(1) Concentrated Wright's stain (stock solution).

(2) Neutral distilled water.

Technique

(1) Dry smear in air.

(2) Cover smear with ten drops of concentrated Wright's stain for one minute.

(3) Add ten drops of neutral distilled water for seven to ten minutes.

(4) Wash with distilled water.

(5) Dry in air and examine.

Remarks

(1) The smear is fixed by the concentrated Wright's stain.

(2) Precipitation of the stain occurs after dilution with distilled water. The time required for this part of the procedure varies and should be established by trial with each new lot of concentrated Wright's stain.

(3) After addition of distilled water to the Wright's stain on the slide, a thin scum should appear on the surface. This should be flooded off the slide at the end of the staining period.

(4) This stain is primarily used for cytologic studies. Red cells stain buff color; the granules of neutrophiles, lilac; the granules of eosinophiles, bright red; and of basophiles, deep blue. If the solution is too acid the erythrocytes are bright red and leucocyte nuclei are pale blue to colorless. If the solution is too alkaline the red cells are a slate blue and there is little differentiation.

c. Giemsa stain.

Materials required.

(1) Concentrated Giemsa stain (stock solution).

(2) Chemically pure (acetone free) methyl alcohol.

(3) Neutral distilled water.

(4) 95% ethyl alcohol.

(5) Two Koplin jars or deep staining dishes.

(6) Two glasses.

Technique

Long Method

(1) Fix smear in C.P. (acetone free) methyl alcohol in Koplin jar overnight.

(2) Stain with dilute Giemsa stain in incubator at 37° Centigrade for one hour (one drop concentrated Giemsa stain to 2cc neutral distilled water).

(3) Decolorize in two changes of 95% ethyl alcohol for five seconds each.

(4) Dry in air and examine.

Short Method

(1) Fix smear in C.P. (acetone free) methyl alcohol for thirty minutes.

(2) Stain with dilute Giemsa stain in incubator at 37° Centigrade for one hour.

(3) Decolorize in two changes of 95% ethyl alcohol for five seconds each.

(4) Dry in air and examine.

Remarks

(1) Giemsa stain requires neutral distilled water. If the water is alkaline the preparation will be blue and muddy; if acid the preparation will be too red, although a slight degree of acidity can be tolerated. Distilled water standing in a poor grade of glass rapidly becomes alkaline; a pyrex glass bottle is satisfactory.

(2) The long method of fixation gives better staining results and is preferable except in an emergency.

(3) Bacteria are stained blue, initial bodies blue, and elementary bodies red. Cellular components are stained differentially in a manner similar to Wright's stain.

d. Ziehl-Neelsen's stain for Mycobacterium (acid fast)

Materials

(1) Ziehl's carbol fuchsin.

(2) Loeffler's alkaline methylene blue.

(3) Acid alcohol (95% ethyl alcohol containing 3%, by volume, concentrated hydrochloric acid).

Technique

(1) Fix smear in flame.

(2) Stain with Ziehl's carbol fuchsin solution by gentle steaming for three to five minutes or cold for fifteen minutes.

(3) Wash in water.

(4) Decolorize in acid alcohol until only a suggestion of pink remains.

(5) Wash in water.

(6) Counterstain with Loeffler's alkaline methylene blue fifteen to twenty seconds.

(7) Wash, dry and examine.

Remarks

(1) Acid fast bacteria stain red, others blue, background blue.

(2) Acid fast bacteria are: tubercule bacillus, leprosy bacillus, smegma bacillus and about forty other nonpathogenic bacteria from butter, hay and dung.

6. Culture techniques

A. Preparation of culture from conjunctiva (Petri plate).

a. Materials required

(1) Platinum loop.

(2) Alcohol lamp or bunsen burner.

(3) Culture medium in Petri plate.

b. Technique

(1) Heat platinum loop in flame until red hot.

(2) Allow to cool.

(3) For right eye, evert lower lid with thumb of left hand holding upper lid away from field with index finger. For left eye, extend arm around and behind head everting lower lid with index finger and holding upper lid away from field with thumb.

(4) Pick up secretion from lower fornix or caruncle on loop, or if secretion is scanty draw loop lightly and quickly from caruncle across lower fornix four or five times.

(5) Pick up cover of Petri plate with left hand, holding it two or three inches directly above the lower portion.

(6) Draw the loop lightly across the surface of the medium.

(7) Flame the loop.

(8) Repeat for other eye.

c. c. Remarks

(1) Cultures always should be made from each eye even though one may appear to be normal.

(2) Make inoculation from one eye on half the surface of the Petri plate. Use the remainder of the plate for the other eye.

(3) Mediums usually prepared in Petri plates are blood agar, chocolate agar, McLeod's medium, phenol red mannitol agar, and tellurite medium.

B. Preparation of culture from conjunctiva (tubed medium)

a. Materials required

(1) Platinum loop.

(2) Alcohol lamp or bunsen burner.

(3) Culture medium - one tube or slant for each eye.

b. Technique

(1) Loosen plug in tube but do not remove.

(2) Heat platinum loop in flame until red hot.

(3) Allow to cool.

(4) Evert lower lid holding upper lid away from field.

(5) Pick up secretion as described above.

(6) Hold tube in left hand.

(7) Grasp and remove plug with small finger of right hand.

(8) Flame mouth of tube.

(9) Inoculate medium by inserting loop into tube without touching sides and:

(a) In the use of slants, draw loop across the surface of the medium from below upward.

(b) In the use of thioglycollate broth medium, disperse material from loop in lower portion of medium.

(c) In the use of other fluid mediums, disperse material from loop in upper portion of medium.

(10) Withdraw loop without touching sides of tube.

(11) Flame mouth of tube.

(12) Reinsert plug.

(13) Flame loop.

(14) Label tube.

c. Remarks

(1) Use a separate tube for each source of material.

(2) The usual tube mediums are: Loeffler's slant, Sabouraud's slant, Corper's medium, brain broth medium, and thioglycollate medium.

C. Cultures - general remarks.

a. Preparation of various culture mediums is described in Army Laboratory Manuals.

b. Cultures should be placed in an incubator as soon as possible after they are taken.

c. Cultures for routine cases should be incubated at 37° Centigrade under ordinary atmosphere for a minimum of forty-eight hours. They should be examined at twenty-four and forty-eight hours for gross identification of colonies and for selection of colonies for isolation and identification by subculture methods.

d. Cultures for gonococcus or meningococcus should be made upon McLeod's medium and incubated at 37° Centigrade under an atmosphere containing ten percent carbon dioxide gas.

e. Cultures for higher bacteria and fungi should be made upon Sabouraud's medium and incubated over night at 37° Centigrade; then at room temperature for a minimum of one week. Daily observation should be made for growth.

f. Cultures in cases of tuberculosis should be made upon Corper's medium and incubated at 37° Centigrade for a minimum of two weeks with daily observation for growth. Cultures should be made with the platinum spatula and scraping technique.

g. Adequate labeling of cultures is necessary to avoid loss or confusion. The culture container (Petri plate or tube) should be marked in addition to filling out laboratory slip. Name, date and source of culture should be included.

h. Cultures from both eyes may be made upon the same Petri plate. For ease of identification of the source of the culture the plate may be streaked in the following manner:

The imprint of the loop in making the streak persists.

7. Test for effectiveness of Penicillin.

A. One-half cc suspensions of pure cultures of the organism to be tested are made into:

a. Nutrient broth containing five units of penicillin per cc of medium and culture.

b. Nutrient broth.

B. Both subcultures are incubated at 37° Centigrade for forty-eight hours with comparative readings of growth at twenty-four and forty-eight hours. (A more rapid comparison may be made by incubating the tubes in a water bath at 37° Centigrade with constant shaking for eighteen hours.)

C. Definite inhibition of growth or no growth in the tube containing penicillin as compared with good growth in the tube of nutrient broth is an indication of the effectiveness of penicillin against the organism being tested. Comparable amounts of growth in the two tubes indicates resistance of the organism to penicillin.

8. Diagnostic animal inoculations (should be made by one familiar with animal pathology).

A. Guinea pig inoculation.

a. For tuberculosis (see Simmons and Genzko).

(1) Biopsy material taken from the lids, conjunctiva or regional lymph nodes is placed in a sterile specimen bottle, without a fixative, sealed and transmitted to the laboratory as quickly as possible.

(2) Laboratory officer should be notified in advance of the biopsy.

b. For determining pathogenic corynebacteria (Diphtheria). For technique, see Simmons and Genzko.

(1) Cultures are made upon Loeffler's slants from cases of suspected diphtheritic infection. Corynebacteria isolated from these cultures are isolated in pure culture and tested for virulence.

B. Rabbit corneal inoculations.

a. Materials required.

(1) Inoculum (fluid from vesicles, epithelial covering of vesicles, or corneal scraping material).

(2) 5% Cocaine solution.

(3) Platinum spatula or Graefe knife.

b. Technique

(1) Anesthetize rabbit's cornea with three to five drops of 5% Cocaine (instill one drop a minute).

(2) Excoriate rabbit's cornea superficially with sterile platinum spatula or Graefe knife.

(3) Transfer inoculum on to cornea.

(4) Massage material on cornea with spatula or flat surface of Graefe knife.

(5) Observe rabbit daily for one week.

C. Interpretation of results.

(1) Rabbit's cornea heals from trauma of inoculation within six to twelve hours.

(2) As a result of inoculation with material containing herpes simplex virus, vaccine virus or smallpox virus, corneal lesions develop resembling human herpetic keratitis, dendritic keratitis, or disciform keratitis.

(3) When one of these lesions has developed, the cornea is carefully removed for pathologic examination for inclusion bodies.

(4) Herpes simplex is characterized by intranuclear acidophilic inclusion bodies. Vaccinia and variola are characterized by cytoplasmic inclusion bodies.

(5) Rabbits may develop an endophthalmitis and encephalitis following the corneal inoculation with herpes simplex virus.

III. Immunologic Reactions

1. Serologic tests

A. Blood for serologic tests is drawn aseptically from a vein with a sterile dry 10cc or 20cc syringe fitted with a 20 gauge needle 1 1/2" long. The blood is immediately transferred to sterile tubes which do not contain anticoagulants and sealed for transportation to the laboratory. For a single test 5cc of blood should be drawn, and 1cc more should be drawn for each additional test.

2. Skin tests

A. Tuberculin test

a. Materials required

(1) Tuberculin syringe (1cc graduated to 0.01cc).

(2) 25 gauge 1/2" hypodermic needle.

(3) Purified protein derivative tuberculin.

Item No. 1489500 Tuberculin First Test Strength.

Item No. 1489600 Tuberculin Second Test Strength.

The issue item is a package containing two vials, each with one tablet of tuberculin and one 1cc vial of sterile buffered diluent. The vials are rubber stoppered.

b. Test

(1) Sterilize rubber stoppers of diluent vial and one tablet vial.

(2) Transfer 0.5cc of diluent to vial containing tablet with sterile tuberculin syringe and hypodermic needle.

(3) Mix contents thoroughly until tablet is completely dissolved (ten minutes).

(4) Inject 0.1cc tuberculin solution intradermally on forearm after site has been thoroughly cleansed with 70% alcohol.

c. Interpretation of test.

(1) A positive test may produce:

(a) A local reaction at the site of injection.

(b) A local reaction and a focal reaction.

(c) A local reaction and a general reaction.

(d) A local reaction, a focal reaction, and a general reaction.

(2) A positive local reaction may vary from an elevated induration 0.5cm in diameter, surrounded by a zone of erythema to a large zone of erythema with necrosis of the skin at the site of injection. This test is evaluated at forty-eight hours after the injection.

(3) A focal reaction consists of an exacerbation of signs and symptoms of an active tuberculous lesion. This type of reaction may occur within twelve to twenty-four hours after the injection.

(4) A general reaction is indicated by an elevation of temperature which usually occurs between twelve and twenty-four hours after the injection.

d. Cautions

(1) A patient should be hospitalized at least forty-eight hours before the test. Temperatures should be taken at least every four hours during this period and for forty-eight hours after the injection as follows:

(a) The thermometer should be held under the tongue with the lips closed for five minutes.

(b) The temperature should not be taken for thirty minutes after the patient has been in a cold atmosphere.

(c) The temperature should not be taken for thirty minutes after a hot meal or a cold drink.

(2) The second test strength should never be used until no reaction has been obtained with the first test strength tuberculin.

(3) The tuberculin test should never be done until after a general physical examination including X-ray examination has been made to exclude active tuberculosis other than in the eye.

(4) Cases of suspected intraocular tuberculosis should have the involved eye under cycloplegia before the test is made.

e. Remarks

(1) The tuberculin contained in the test dose (0.1cc) is:

First strength test = 0.00002 mg.
Second strength test = 0.005 mg.

B. Frei test (specific intradermal test for lymphogranuloma inguinale similar to the tuberculin test).

a. Materials required

(1) Two tuberculin syringes.

(2) Two 25 gauge 1/2" hypodermic needles.

(3) Frei antigen and control solution.

Item No. 1703300 antigen lymphogranuloma venereum (Frei test and control) The issue item is a package containing a vial of the Frei antigen in proper dilution and a vial of control solution.

b. Test

(1) Sterilize rubber stopper of antigen vial and control vial.

(2) Withdraw 0.1cc of antigen and 0.1cc of control solutions in separate sterile tuberculin syringes.

(3) Cleanse both forearms with 70% alcohol.

(4) Inject 0.1cc of antigen solution intradermally on one forearm.

(5) Inject 0.1cc of control solution intradermally on other forearm.

c. Interpretation of test.

(1) A positive reaction is characterized by the appearance of a raised erythematous tubercle 0.5cm to 1cm in diameter at the site of injection of the antigen without reaction at the control site within forty-eight to seventy-two hours.

C. Skin test for Trichinosis

a. Materials required.

(1) Two tuberculin syringes.

(2) Two 25 gauge 1/2" hypodermic needles.

(3) Trichinella extract and control solution (not an issue item).

b. Test

(1) Sterilize rubber stoppers of extract vial and control vial.

(2) Withdraw 0.1cc of extract and 0.1cc of control solution in separate sterile tuberculin syringes.

(3) Cleanse both forearms with 70% alcohol.

(4) Inject 0.1cc extract intradermally on one forearm.

(5) Inject 0.1cc control solution intradermally on other forearm.

c. Interpretation of test.

(1) A positive reaction indicating infestation within five years is of the immediate type.

(2) Within twenty minutes an elevated blanched wheal 8mm to 15mm in diameter appears at the site of injection of the extract. Pseudopods may or may not radiate into the surrounding zone of erythema. This reaction is contrasted with any which may appear at the site of injection of the control solution.

(3) Skin sensitivity to trichinella extract usually does not develop in less than two weeks after appearance of symptoms.

D. Allergy tests

a. Scratch tests or intradermal tests give best results when done and interpreted by an experienced allergist. Occasionally intradermal tests produce an acute exacerbation of an allergic disease or precipitate an allergic crisis. Therefore, these tests should not be performed by the Ophthalmologist unless he also has had special training in allergy.

b. Patch tests

Materials required

(1) Piece of gauze two or three layers thick and one-half inch square.

(2) Adhesive tape, 1" x 2".

(3) Substance to be tested.

Test

(1) Cleanse skin of forearm with 70% alcohol and allow to dry.

(2) Place substance to be tested on gauze.

(3) Apply gauze to skin of forearm with adhesive tape.

(4) Leave patch test in place for forty-eight hours unless definite symptoms of itching appear sooner.

(5) Control test with untreated gauze and adhesive tape should be used on opposite forearm.

Interpretation of test.

(1) A positive reaction is characterized by intense itching. Upon removal of the patch one or more small vesicles surrounded by erythema signifies a minimal reaction. More intense reactions may show a typical wheal with pseudopod-like extensions into the surrounding zone of erythema.

(2) Absence of itching and skin changes after the patch has been applied for forty-eight hours is a negative reaction.

Remarks

(1) A careful "contact" history should be taken to determine the probable initating substance or substances before the test is made.

(2) If several substances need to be tested the patches may be applied to the back.

c. Conjunctival test

Materials required

(1) Substance to be tested.

(2) Conjunctival irrigator.

Test

(1) Material to be tested is placed in lower fornix of conjunctiva.

(2) Conjunctiva is irrigated with sterile saline or boric acid solution after five minutes to remove all of the test material.

Interpretation

(1) Itching and conjunctival injection developing within ten minutes to two hours is a positive reaction. More intense reactions are accompanied by edema or chemosis of the conjunctiva, and the lids, corneal infiltrations and occasionally phlyctenule-like lesions of the conjunctiva or cornea.

Cautions

(1) No more than one substance should be tested in one eye on any day.

(2) This test should be used only after other methods of testing sensitivity have failed.

(3) An inflamed or diseased eye should not be used for this test.

IV. Pathologic Examination

A. Biopsy

Immediately after removal place the specimen in twenty times its volume of 10% Formalin (4% formaldehyde) and send to laboratory immediately. If the specimen has to be shipped some distance to a laboratory, it should be kept for twenty-four hours in the original amount of fixative, then it may be placed in a wide mouth bottle with a smaller amount of fixative and prepared for shipment.

B. Enucleated Eye

Immediately after removal place eye in 300cc of 10% Formalin for forty-eight hours. The eye should not be opened. After forty-eight hours the eye should be packed in cotton soaked in 10% Formalin, sealed in a bottle and mailed to: The Curator, Army Medical Museum, War Department, Washington, D.C.